Simulation of Self-synchronized ADS using UDP/IP Network

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Introduction

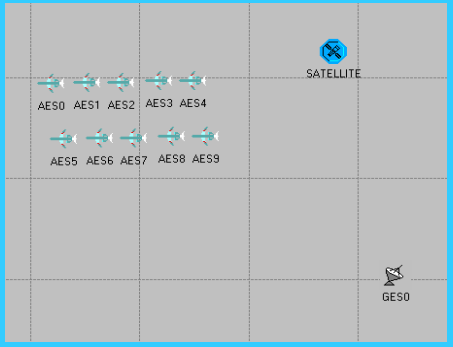
- ADS
  - ADS using a satellite has been introduced to the oceanic air traffic control for surveillance recently.
  - Positions of aircraft flying over the ocean can be monitored in real-time using ADS accurately
  - ADS reports
    - Be transmitted through a data link to an air traffic control center.
    - transfer through a data link that meets present ICAO AMSS SARPs suffers a substantial delay
      - delay may further increase for the traffic congestion
- Self-synchronized ADS
  - ENRI Proposed the ADS using a satellite as future system
    - Character: small delay, more efficient use of channels, etc..
    - Presented in the ACP WGC7 in 2004 and the 3rd NexSAT in 2003
- Network of New AMSS
  - use Internet Protocol (IP)
- Computer Simulation
  - Results of Simulation of self-synchronized ADS using UDP/IP network

Part of Development Program

Development Program of Simulator for New Generation Aeronautical Satellite Communication System using IP in Japan

Simulator

OPNET



(Calculation Software for Simulation)

Sub Model

- IP (Internet Protocol) Model
- Satellite Link Model
- Air Traffic Model

Evaluate

Performance
(Delay, Throughput, etc.)

Technical information
on the protocol of NGSS

Service Providers

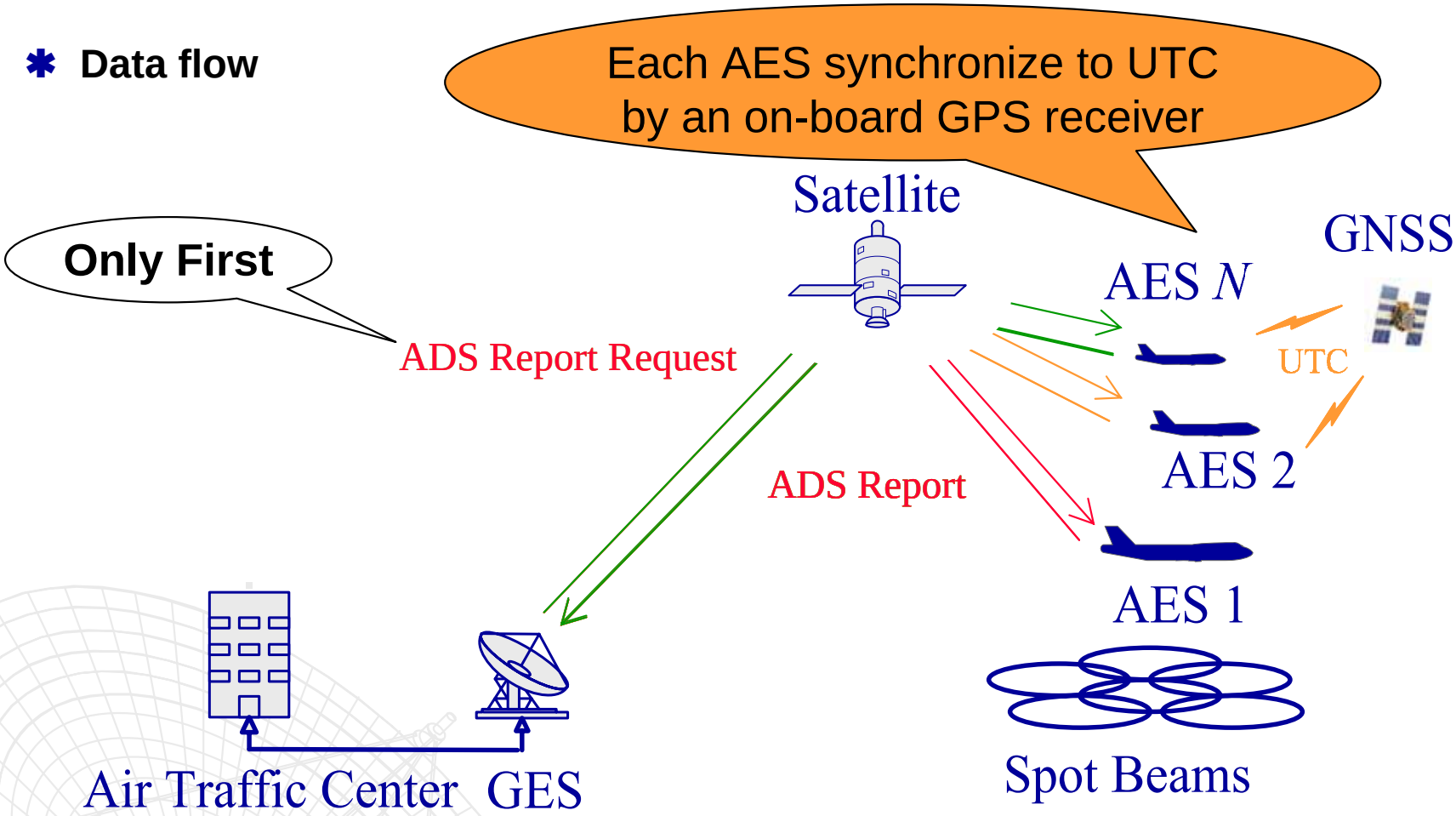
Schedule of Evaluation Program

Year	Plan
2006	Development of IP model software and Simulation
2007	Development of Satellite link model software and Simulation
2008	Development of Air traffic model software and Simulation

Evaluate the simulation of each model in each year

Self-synchronized ADS

✱ **Data flow**



✱ Merit : Support more efficient use of channels

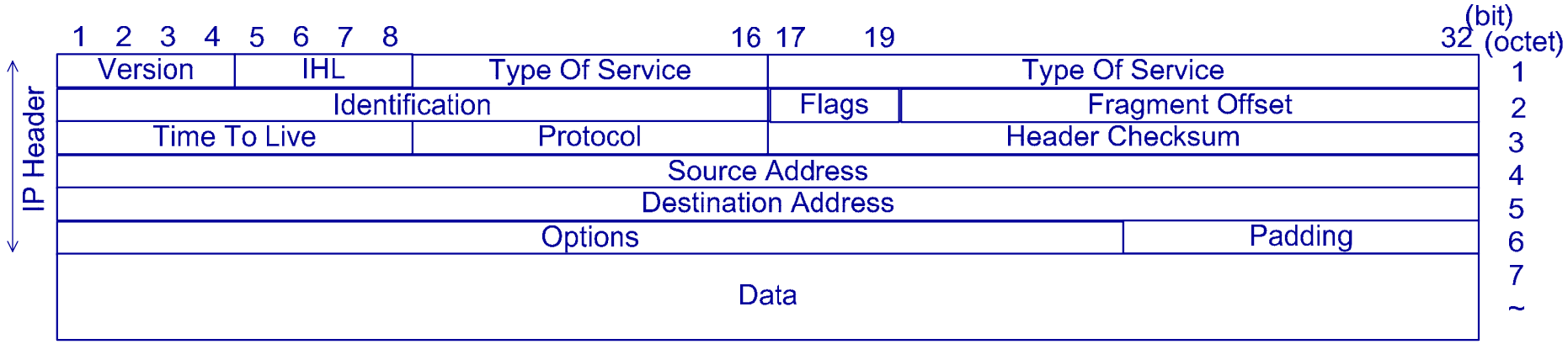
- ✈ Required number of channels for ADS report request transmissions decreases
- ✈ Channel throughput increases
- ✈ ADS report loss rate decreases
- ✈ Guard time can be reduced

*** The self-synchronized protocol didn't regulate by ICAO AMSS SARPs**

*** Assumed by ENRI**

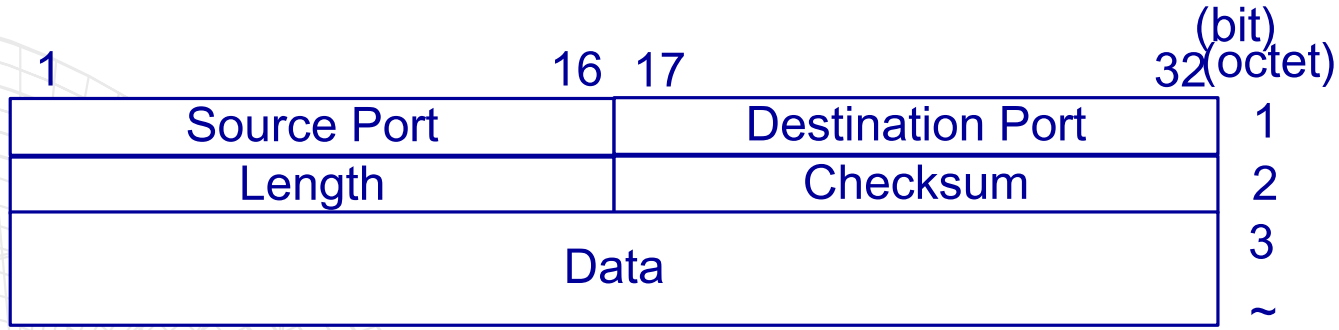
Internet Protocol v4 (IPv4) and UDP

IP



- IP is used in the network of new generation aeronautical satellite system
- Both IP header and data used in the communication thorough IP.
- Header is composed of control information for packet distribution.

UDP

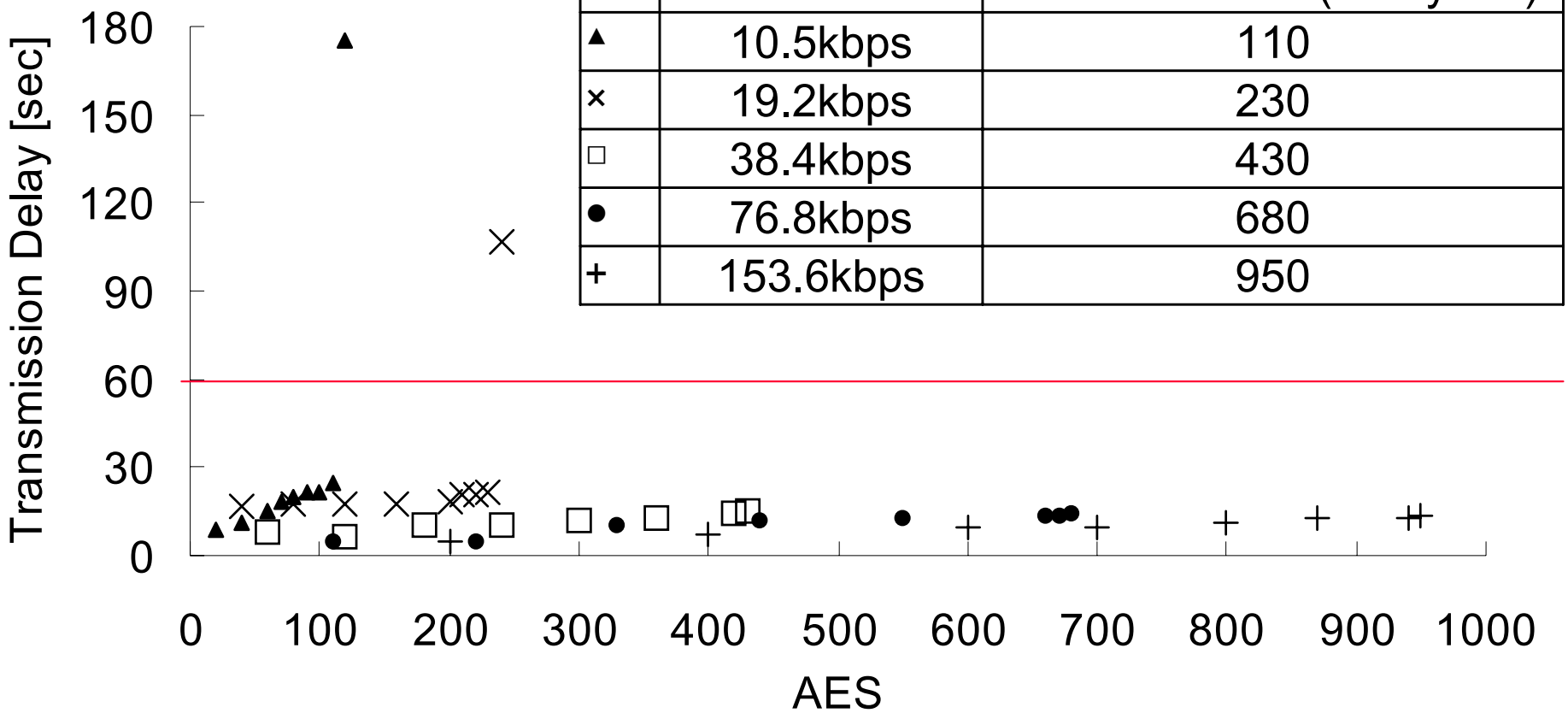


- UDP (User Datagram Protocol) : in transport layer over IP
  - Connectionless protocol
  - Applied in real time connection
  - Delay of UDP is smaller than that of TCP (Transmission Control Protocol)

ADS using UDP/IP network based on Modified Simulator

- Simulate a basic protocol of a self-synchronized ADS using IP network
  - modifying the ADS simulator based on ICAO AMSS standards
- Modified points
  - Addition of ADS report using IP network
  - Addition of channel rate > 10.5kbps
    - 19.2kbps,38.6kbs,76.8kbps,153.6kbps
    - +Assume the ADS with self-synchronized protocol and UDP
      - Retransmissions of last data are not included in UDP/IP
- Parameter setting of Simulation
  - IP network: UDP/IP
  - Data length of ADS report: 223octet (T-channel)
    - Latitude, Longitude, Altitude, Time, etc.
  - Transmission Periods of ADS report: 64 seconds, 184 seconds
  - Channel rate: 10.5kbps, 19.2kbps, 38.4kbps, 76.8kbps, 153.6kbps
  - Number of AES: Variable (~2000)
    - For performance of simulator
  - Configuration of Channel : Psmc =1, Rsmc=1, Pd=1,Rd=1,Td=1
  - Number of Simulation trials : 5

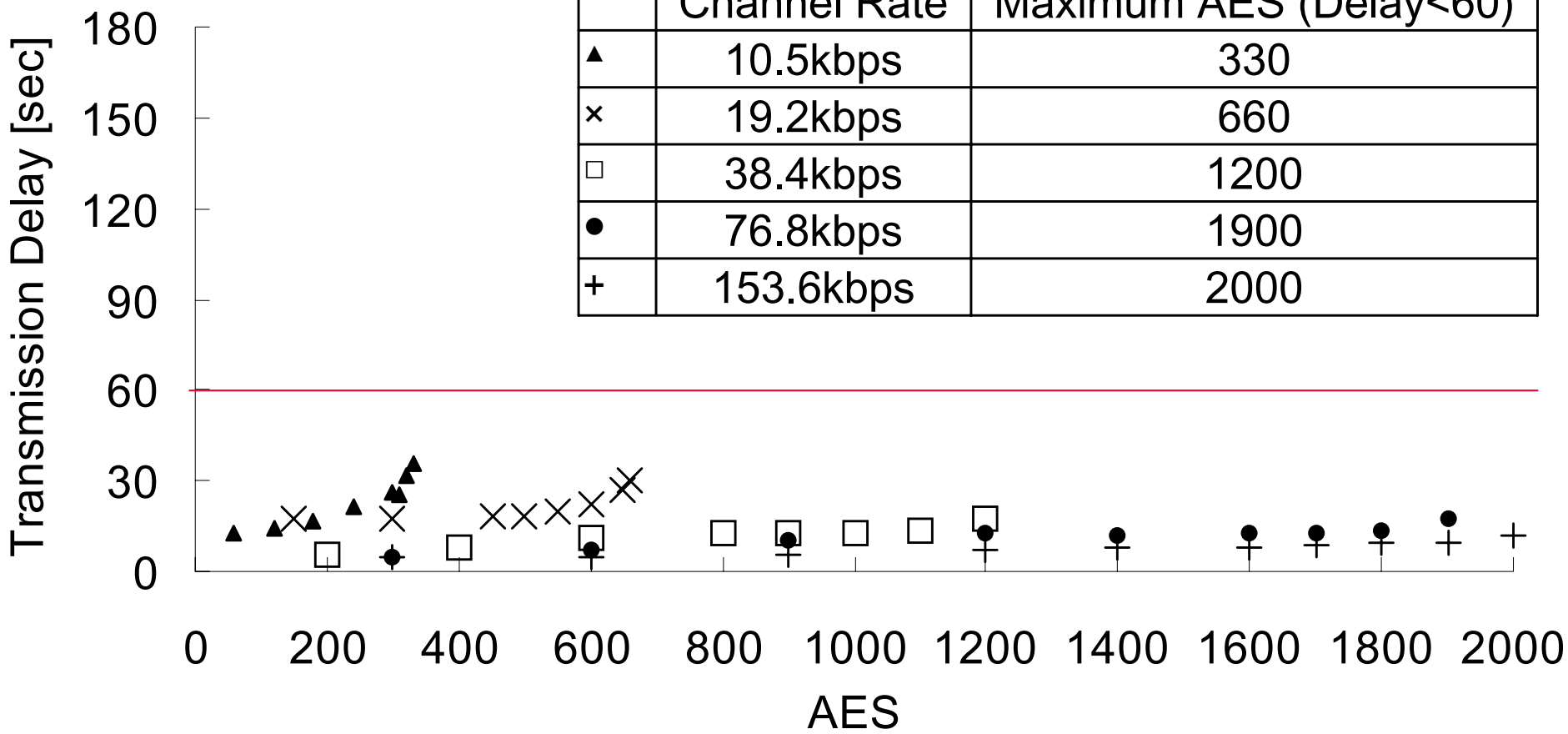
95% Transmission Delay (Transmission Periods:64 seconds)



	Channel Rate	Maximum AES (Delay<60)
▲	10.5kbps	110
×	19.2kbps	230
□	38.4kbps	430
●	76.8kbps	680
+	153.6kbps	950

95% Transmission Delay (Transmission Periods:184 seconds)

	Channel Rate	Maximum AES (Delay<60)
▲	10.5kbps	330
×	19.2kbps	660
□	38.4kbps	1200
●	76.8kbps	1900
+	153.6kbps	2000



Conclusion

- Results of simulation of self-synchronized ADS in an IP network
- Assumed the ADS with a self-synchronized protocol and UDP
  - UDP/IP is applied in the real time connection
  - Retransmissions of last data are not included in UDP/IP
- **Results of Simulation**
  - **ADS report is transmitted every 64 seconds in the case of 10.5kbps,**
    - **maximum number of AES of 95% transmission delay (< 60 sec) is 110**
  - **ADS report is transmitted every 64 seconds in the case of 153.6kbps**
    - **maximum number of AES of 95% transmission delay (< 60 sec) is 950**
  - **ADS report is transmitted every 184 seconds in the case of 153.6kbps**
    - **maximum number of AES of 95% transmission delay (< 60 sec) is over 2000**
- **Self-synchronized ADS has a potential to treat a lot of AES with a little delay**

Thank you

for your attention

ENRI